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BRIEF - PATENTS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicants:	R. Timmis et al.	Attorney Docket No.	WEYE116514/22822A
Application No:	09/700,037	Group Art Unit:	1651
Filed:	July 2, 2001	Examiner:	L.B. Lankford, Jr.
Title:	METHODS FOR CLASSIFICATION OF SOMATIC EMBRYOS		

APPELLANTS' APPEAL BRIEF

Federal Way, Washington 98063
February 24, 2006

TO THE COMMISSIONER FOR PATENTS:

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TABLE OF CONTENTS

I. REAL PARTY IN INTEREST

The real party in interest is Weyerhaeuser Company, a Washington corporation, having a principal place of business at 33663 Weyerhaeuser Way South, Federal Way, Washington 98063. Assignment of the present patent application and the invention from the parties named in the application to the real party in interest was recorded at Reel 011948, Frame 0513.

II. RELATED APPEALS AND INTERFERENCES

Two divisional applications have been filed based on the present application-Application Nos. 10/680,675 and 10/680,676, both filed on October 7, 2003, and both finally rejected on June 20, 2005. On September 20, 2005, a Notice of Appeal was filed in each of these two cases, and an Appellants' Appeal Brief in each of these cases is concurrently filed with the present Brief.

III. STATUS OF CLAIMS

Claims 27-41 are pending in this case. All Claims 27-41 have been finally rejected in the final Office Action mailed June 20, 2005, and appealed.

IV. STATUS OF AMENDMENTS

There are no outstanding amendments to this application.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Claim 27 is the only independent claim pending in the present application.

Claim 27 is directed to a method for classifying plant embryos according to their quantifiable characteristics, such as their potential to successfully germinate and grow into normal plants, based on *spectral data* obtained from the plant embryos. The method involves generally four steps. First, *spectral data* are obtained from reference plant embryos of known quantifiable characteristics. Spectral data from embryos mean data related to absorption, transmittance, or reflectance of electromagnetic radiation at multiple discrete wavelengths by the embryos, for example, data obtained in NIR (near-infrared) spectroscopy. (Page 10, lines 20-21; page 11, lines 26-29 of the specification.) In a simple case, the reference plant embryos of known quantifiable characteristics are divided into two groups: those that are known to have favorable quantifiable characteristics, e.g., those that are likely to geminate and grow into normal plants; and those that are known to have unfavorable quantifiable characteristics, e.g., those that are unlikely to germinate and grow into normal plants. (Their quantifiable characteristics are known or ascertained based on a follow-up study, for example.) Thus, each spectral data set obtained from each reference plant embryo is correlated to the known quantifiable characteristics of that reference plant embryo.

Second, one or more classification algorithms are applied to the spectral data sets, each being correlated to the known quantifiable characteristics of the reference plant embryo from which the data set is obtained, to develop a classification model for classifying plant embryos according to their presumed quantifiable characteristics. Essentially, a "classification model" (or a classifier) is a system that identifies an input by recognizing that the input is a member of one of a number of possible classes. Various classification algorithms are available to develop a classification model. Some non-limiting examples are listed in the specification, at page 8, line 15-page 9, line 8, and include principal components analysis, artificial neural networks, Bayesian Classifiers, Probably Approximately Correct (PAC) Learning, Radial Basis

Functions, Nearest-Neighbor Methods, and the Lorenz curve method. In one example described in the specification, at page 37, line 13-page 38, line 10, an NIR (near infrared) spectroscopic setup was used to collect spectral data from a set of reference plant embryos of known quantifiable characteristics, and the collected spectral data were subjected to principal component analysis. Principal component analysis, as well known in the classification art, involves a mathematical procedure that transforms a number of (possibly) correlated variables in the original data into a (smaller) number of uncorrelated variables called *principal components*. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. In other words, the first principal component is the projection on the direction in which the variance of the projection is maximized, and each succeeding component is the projection on the direction in which the remaining variance is maximized. Thus, principal components are "meaningful" variables, in the sense that they are highly indicative of the variance (leading to classification) of the data.

Referring back to the example in the specification, at page 38, line 11-page 39, line 9, principal component analysis is applied to the spectral data collected from reference plant embryos using a software package, "the Unscrambler," available from Camo ASA and its results are shown in FIGURE 2A. In this example, reference plant embryos were divided into four groups: Douglas-fir zygotic embryos of three different developmental stages (mature dry zygotics - noted as black circles in FIGURE 2A; "August 14" immature zygotics - white triangles; and "July 23" immature zygotics - black squares) and somatic embryos from Genotype 1 ("+" symbols). FIGURE 2A shows that these four populations of varying embryo quantifiable characteristics can be separated into four clearly distinct groups when plotted with respect to the first three principal components obtained from the principal component analysis. In other words, the spectral data collected from the reference plant embryos and analyzed using principal component analysis are clearly "correlated" to the four populations

of varying quantifiable characteristics. Thus, these results are used to form a classification model to classify a plant embryo of unknown embryo quantifiable characteristics.

Third, spectral raw data are obtained from plant embryos of *unknown* quantifiable characteristics.

Fourth, the classification model is applied to the spectral raw data of embryos of unknown quantifiable characteristics, to thereby classify those plant embryos of unknown quantifiable characteristics according to their *presumed* quantifiable characteristics. Continuing to use the example described in FIGURE 2A of the specification, when spectral data are obtained from a plant embryo of unknown quantifiable characteristics (i.e., a plant embryo belonging to one of the four populations in this example), the first three principal components are calculated from the spectral data and are plotted in FIGURE 2A. Depending on where these three principal components are plotted in FIGURE 2A, the plant embryo of unknown quantifiable characteristics, from which the spectral data are obtained, can be classified into one of these four populations of varying embryo quantifiable characteristics.

It should be understood that FIGURE 2 represents merely one example of a classification model, which could be developed in accordance with the present invention. The specification provides other examples, at page 40, line 7-page 45, line 14. In particular, FIGURE 4A shows two groups of embryos of high-quality appearance ("+") and low-quality appearance (black circles) plotted with respect to the first three principal components, and FIGURE 5A shows two groups of embryos of high-quality morphology ("+") and low-quality morphology (black circles), again plotted with respect to the first three principal components. "These results demonstrate that principal component analysis of spectral data from somatic embryos having high- and low-quality morphological appearance provides a basis for developing a classification model that will allow somatic embryos to be rapidly categorized with regards to their germination potential." (Specification, page 42, lines 19-23.) In other words, using principal component analysis, spectral data from embryos of known quantifiable

characteristics can be "correlated" to their quantifiable characteristics, and the correlation is used to build a classification model for classifying embryos of unknown quantifiable characteristics based on the spectral data obtained from those embryos of unknown quantifiable characteristics.

It should be understood that principal component analysis is merely one example of a classification algorithm that can be applied to spectral data obtained from plant embryos to develop a classification model, and one or more of any other classification algorithms may be used instead.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

In the final Office Action mailed June 20, 2005, all pending claims (Claims 27-41) were finally rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Further, all the claims were found to contain subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 27-41 were also rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over Chi et al. (*J. of Fermentation and Bioengineering 81*(5)) and/or Vits et al. (*AIChE Journal 40*(10)).

VII. ARGUMENT

Appellants respectfully submit that the Examiner's rejection of the present application under 35 U.S.C. § 112, first paragraph, under 35 U.S.C. § 102(b), and under 35 U.S.C. § 103(a), was in error, and should be reversed.

1. The Specification as Filed Clearly Meets the Written Description Requirement Under Section 112, First Paragraph, for Claims 27-41

The Examiner has rejected Claims 27-41 under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s) had possession of the claimed invention.

More specifically, the Examiner found as follows:

> Applicant claims a method for classifying plant embryo[s] 'according to their quantifiable characteristics,' yet within the specification as originally filed, there is no clear correlation drawn between the data collected and compared and the desired 'characteristic,' i.e., the ability to germinate, of an embryo. Applicant has not clearly established what the correlation is and thus it is unclear that applicant actually had within their possession a method for actually classifying plant embryo quality....
>
> It follows logically that the claimed invention has not been enabled by the instant specification because applicant has not taught how to classify embryos *wherein the 'spectral data' of an embryo is used as a standard to which embryos of unknown 'characteristics' are compared* wherein if the data matches(?) then the unknown is classified as having the same characteristic which would appear to be applicant's invention. The specification shows no correlation between 'spectral data' and desired characteristics but only between *'the spectral data' of one embryo and 'the spectral data' of a subsequent embryo.*
>
> It would appear that applicant is claiming that if an unknown embryo has the same 'spectral data' as the reference embryo then it has the same desired 'characteristic,' i.e. the ability to germinate, but applicant has not set forth how a different result is to be classified. Thus applicant has not described or enabled how to classify an embryo. *What parameters or data would show that an embryo is of lesser desired characteristic? Greater desired characteristic?* There appears to be

> no indication of how the reference and model are used to classify the desired 'characteristic' of an embryo.

(Final Office Action, pages 3-4, emphasis added.)

As a preliminary matter, it is noted that the Examiner appears to have misunderstood the present invention as directed to directly comparing the spectral data of a reference embryo and the spectral data of an embryo having unknown characteristics. To the contrary, as discussed above, the present invention is directed to developing a *classification model* by applying one or more classification algorithms to the spectral raw data collected from plural reference embryos, and then *applying the developed classification model* to the spectral raw data of an embryo of unknown quantifiable characteristics.

In the above-quoted language, the Examiner appears to be asserting that the present specification has not clearly described a specific (or universal) correlation between the acquired spectral raw data from plant embryos and their quantifiable characteristics. In other words, the Examiner appears to be objecting to that the specification did not identify a particular set of "parameters or data" that can always be used as reliable indicators of specific quantifiable characteristics. For example, the Examiner appears to be demanding that the specification includes a specific correlation statement, such as "if a plant embryo has color X, then the embryo is deemed as likely to successfully germinate."

Appellants respectfully submit that the present invention is *not* directed to requiring to first identify a particular set of parameters or data that can be always used as indicative of specific quantifiable characteristics of plant embryos. Such an approach had been tried in the past prior to the present invention. Specifically, as described in the background section of the present application, "[it] has been proposed to use some form of instrumental image analysis for embryo selection.... All of these methods require considerable *pre-judgment* of which morphological features are important and the development of mathematical methods to extract this information from the image. Relatively little of the information from the image has actually been used." (Specification, page 2, lines 20-29.) In other words, all of these

prior methods required first identifying what parameters or data are indicative of specific quality of plant embryos, and used only those limited number of parameters or data.

To the contrary, the present invention is directed to developing a classification model by applying one or more classification algorithms to the spectral raw data collected from the reference embryos of known quantifiable characteristics, without requiring first identifying what parameters or data are indicative of specific quantifiable characteristics. Therefore, different classification models are developed based on different sets of spectral data obtained from reference embryos, respectively.

Accordingly, appellants respectfully submit that the lack of disclosure of particular parameters or data that indicate specific quantifiable characteristics in this case does not raise any issue under 35 U.S.C. § 112, first paragraph, because the present invention as claimed is *not* directed to requiring to identify such parameters or data.

Appellants further respectfully submit that the specification clearly describes how a classification model is developed, which correlates the acquired spectral data from reference embryos and their known quantifiable characteristics. The specification also clearly describes how the classification model is used to correlate the acquired spectral data from embryos of unknown quantifiable characteristics and their presumed quantifiable characteristics, to thereby classify embryos of unknown quantifiable characteristics according to their presumed quantifiable characteristics. The invention of Claim 27, as summarized above, is broadly described in the specification at page 12, line 27-page 13, line 8.

More specifically, the specification at page 11, line 26-page 12, line 26 describes how spectral data are acquired for plant embryos of known quantifiable characteristics. The specification at page 13, lines 3-30 describes how training sets are used in classification algorithms to develop a classification model. Reference is made back to the foregoing passages at page 11, line 26-page 12, line 26 and the description of how spectral raw data can be obtained from a plant embryo. This same technique is useful in collecting the spectral data

from a plant embryo of unknown embryo quantifiable characteristics. Finally, reference is made to page 12, line 35, through page 13, line 2, and to page 5, lines 19-27, where it is described that the developed classification model is applied to the spectral raw data collected from a plant embryo of unknown quantifiable characteristics to thereby classify the plant embryo of unknown quantifiable characteristics. In particular, the specification includes concrete examples of the method of Claim 27, at page 38, line 3, through page 45, line 14, in reference to FIGURES 2A-8B. These examples each graphically shows how a classification model was developed using the well-known principal component analysis, as applied to the spectral raw data obtained from plant embryos, to classify embryos into different groups of different quantifiable characteristics. Still further, the Declaration filed on March 15, 2005, by inventors Timmis, Toland, and Ghermay in the present case sets forth facts that establish that a correlation between spectral data and embryo quantifiable characteristics can be established as recited in Claims 27-41.

In the final Office Action, the Examiner particularly rejected Claim 41 under § 112, first paragraph, noting that "there appears to be no adequate description for the specific qualities applicant claims in Claim 41." (Office Action, page 5, second paragraph.) Appellants note that each and every example of quantifiable characteristics recited in Claim 14 is explicitly described in page 7, lines 28-page 8, line 2 of the application as filed.

Based on the foregoing, appellants respectfully submit that, contrary to the Examiner's finding, the specification as filed describes the correlation between the spectral data collected from embryos and their "quantifiable characteristics." Accordingly, appellants assert that it is clear, in view of the specification as filed, that the inventors were in possession of the invention of Claims 27-41 directed to a method of classifying plant embryo according to their quantifiable characteristics. The specification describes how a classification model is developed and used. The first paragraph of § 112 does not require that a specific *universal* example of a classification model be described. Rather, one skilled in the art reading the

present application would recognize that the inventors had in their possession, at the time of filing, the method directed to a method for classifying plant embryos according to their quantifiable characteristics comprising the steps recited in Claims 27-41. Accordingly, the Examiner's rejection of Claims 27-41 under 35 U.S.C. § 112, first paragraph was in error.

2. The Specification as Filed Clearly Meets the Enablement Requirement Under Section 112, First Paragraph, for Claims 27-41

In the final Office Action, the Examiner further found that the subject matter recited in Claims 27-41 was not described in the specification in such a way as to enable one skilled in the art to make and/or use the invention.

As discussed in the previous section, however, the specification clearly sets forth how a classification model is developed, which correlates the acquired spectral data from reference embryos and their known quantifiable characteristics. Specifically, the specification at page 11, line 26-page 12, line 26 describes how spectral data are acquired for plant embryos of known quantifiable characteristics. The specification at page 13, lines 3-30 describes how training sets are used in classification algorithms to develop a classification model. Reference is made back to the foregoing passages at page 11, line 26-page 12, line 26 and the description of how spectral raw data can be obtained from a plant embryo. This same technique is useful in collecting the spectral data from a plant embryo of unknown embryo quantifiable characteristics. Finally, reference is made to page 12, line 35, through page 13, line 2, and to page 5, lines 19-27, where it is described that the developed classification model is applied to the spectral raw data collected from a plant embryo of unknown quantifiable characteristics to thereby classify the plant embryo of unknown quantifiable characteristics. In particular, the specification includes concrete examples of the method of Claim 27, at page 38, line 3, through page 45, line 14, in reference to FIGURES 2A-8B. These examples each graphically shows how a classification model was developed using the well-known principal component analysis, as applied to the spectral raw data obtained from

plant embryos, to classify embryos into different groups of different quantifiable characteristics.

Accordingly, appellant respectfully submits that one skilled in the art reading the present specification would be enabled to practice the present invention.

3. Claims 27-41 are Novel in View of Chi et al. and/or Vits et al. Under Section 102

Claims 27-41 stand rejected under 35 U.S.C. § 102(b) as anticipated by Chi et al. (*J. of Fermentation and Bioengineering 81*(5)) and/or Vits et al. (*AIChE Journal 40*(10)). Appellants respectfully submit that the rejection in view of Chi et al. and/or Vits et al. was also in error, and submits the following arguments.

As discussed above, the present invention is directed to a method for classifying plant embryos according to their quantifiable characteristics, including generally four steps. First, *spectral raw data* are obtained from reference samples of plant embryos of known quantifiable characteristics. Second, a classification model is developed based on the application of one or more classification algorithms to the *spectral raw data*. Third, *spectral raw data* are obtained from a plant embryo of unknown quantifiable characteristics. Fourth, the developed classification model is applied to the *spectral raw data* of the plant embryo of unknown quantifiable characteristics to thereby classify the embryo according to its presumed quantifiable characteristics.

On the other hand, Chi et al. and Vits et al. both describe methods for classifying embryos based on *image data* (i.e., visible images) obtained from embryos. Specifically, Chi et al. proposes to classify embryos based on "Fourier and size features" of an embryo. (Abstract.) Chi et al., after imaging each embryo, divides each embryo contour into 32 equal-length segments to give rise to 32 Fourier features, and consider those 32 Fourier and size features in classifying embryos. (Page 447, first column, second full paragraph, to second column. See also Figure 2, showing the image of an embryo contour consisting of "32 points".) Likewise, Vits et al. employs "size and size-independent morphological descriptors"

in classifying embryos (Abstract). Like Chi et al., Vits et al. uses "32 arc-length intervals" (Figure 2) in evaluating an embryo image. Therefore, neither Chi et al. or Vits et al. describes a method of classifying plant embryos by developing a classification model based on *spectral data* obtained from plant embryos (such as data obtained in NIR spectroscopy).

The present invention as recited in Claim 27 is directed to a method for developing and using a classification model based on *spectral data* of plant embryos. The method is made possible because differences in spectral data collected from embryos of desirable quantifiable characteristics versus those of undesirable quantifiable characteristics are presumed to reflect differences in chemical composition that are related to embryo quality. (Specification, page 11, lines 29-33.) Chi et al. and Vits et al. are both *completely* silent as to the use of *spectral data* from embryos to develop a classification model, which uncovers subtle relationships between spectral data from an embryo and the chemical properties (and hence the quality or quantifiable characteristics) of the embryo.

Accordingly, appellants respectfully submit that the rejection of Claim 27 under 35 U.S.C. § 102(b) in view of Chi et al. and/or Vits et al. was in error, and Claim 27 is allowable. Since the teaching directed to the use of *spectral data* from embryos to develop and/or apply a classification model was completely missing in each of Chi et al. and Vits et al., Claim 27 cannot be anticipated by either Chi et al. nor by Vits et al. under 35 U.S.C. § 102(b). Appellants further respectfully submit that dependent Claims 28-41 are also believed to be allowable for at least the same reasons why independent Claim 27 is allowable.

4. Claims 27-41 are Nonobvious in View of Chi et al. and/or Vits et al. Under Section 103

Claims 27-41 were further rejected under 35 U.S.C. § 103(a) as being obvious over Chi et al. and/or Vits et al. Appellants respectfully submit that this rejection was also in error. Specifically, as discussed in the previous section, the teaching directed to the use of *spectral data* from embryos to develop and/or apply a classification model (as explicitly recited in Claim 27) was completely missing in each of Chi et al. and Vits et al. Therefore, no *prima facie* case

of obviousness of Claim 27 based on Chi et al. and Vits et al. was made. Therefore, Claim 27 is allowable. Appellants further respectfully submit that dependent Claims 28-41 are also believed to be allowable for at least the same reasons why independent Claim 27 is allowable.

VIII. CLAIMS APPENDIX

1-26. (Canceled)

27. A method for classifying plant embryos according to their quantifiable characteristics comprising:

(a) developing a classification model by

(i) acquiring absorption, transmittance or reflectance spectral raw data of reference samples of plant embryos or any portion thereof of known quantifiable characteristics;

(ii) performing a data analysis by applying one or more classification algorithms to the spectral raw data, the data analysis resulting in development of a classification model for classifying plant embryos by their quantifiable characteristics;

(b) acquiring absorption, transmittance or reflectance spectral raw data of a plant embryo or any portion thereof of unknown quantifiable characteristics; and

(c) applying the developed classification model to the spectral raw data of step (b) in order to classify the plant embryo of unknown quantifiable characteristics according to its presumed quantifiable characteristics.

28. A method according to Claim 27, wherein the absorption, transmittance or reflectance spectral raw data acquired in step (a)(i) is preprocessed using one or more preprocessing algorithms before step (a)(ii); the absorption, transmittance or reflectance spectral raw data acquired in step (b) is preprocessed using one or more preprocessing algorithms; and step (c) is carried out using the preprocessed absorption, transmittance or reflectance spectral raw data.

29. A method according to Claim 28, wherein the preprocessing algorithm reduces noise and adjusts for drift and diffuse light scatter.

30. A method according to Claim 28, wherein the preprocessing algorithm reduces the amount of absorption, transmittance or reflectance spectral raw data yet retains substantially all of the spectral information.

31. A method according to Claim 28, wherein the preprocessing algorithm calculates metrics.

32. A method according to Claim 27, wherein the absorption, transmittance or reflectance spectral raw data is acquired from more than one view of the plant embryo or portion thereof.

33. A method according to Claim 27, wherein the absorption, transmittance or reflectance spectral raw data is acquired from one or more embryo regions selected from the group consisting of cotyledon, hypocotyl and radicle.

34. A method according to Claim 27, wherein the quantifiable characteristics comprise morphology.

35. A method according to Claim 27, wherein the quantifiable characteristics comprise embryo conversion potential.

36. A method according to Claim 27, wherein the plant embryo is a plant somatic embryo.

37. A method according to Claim 27, wherein the plant is a tree.

38. A method according to Claim 37, wherein the tree is a member of the order *Coniferales*.

39. A method according to Claim 37, wherein the tree is a member of the family *Pinaceae*.

40. A method according to Claim 37, wherein the tree is selected from the group consisting of genera *Pseudotsuga* and *Pinus*.

41. The method according to Claim 27, wherein the quantifiable characteristics comprise conversion potential, resistance to pathogens, drought resistance, heat resistance, cold resistance, salt tolerance, preference for light quantifiable characteristics, or suitability for long-term storage.

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

Copies of the Appellant Briefs concurrently filed in the related divisional applications, Application Nos. 10/680,675 and 10/680,676, are attached herewith.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited in triplicate with the U.S. Postal Service in a sealed envelope as first class mail with postage thereon fully prepaid and addressed to Mail Stop Appeal Brief - Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the below date.

Date: 02/24/06

Susan J. Finn